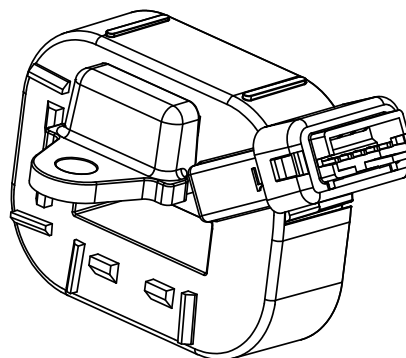


Current Transducer HO-S/SP606 series $I_{PN} = 100, 200, 250 \text{ A}$

Ref: HO 100-S/SP606-1106 , HO 200-S/SP606-1106 , HO 250-S/SP606-1106

For the electronic measurement of current: DC, AC, pulsed..., with galvanic separation between the primary and the secondary circuit.



Features

- Open loop multi-range current transducer
- Voltage output
- Single power supply +5 V
- Overcurrent detection $2.92 \times I_{PN}$ (peak value)
- EEPROM Control
- Galvanic separation between primary and secondary circuit
- Low power consumption
- Compact design for panel mounting
- Aperture: $15 \times 8 \text{ mm}$
- Factory calibrated
- Connection mating with JST:
 - housing PHR-5
 - contact SPH-00xT
- Dedicated parameter settings available on request (see page 11).

Special features

- Internal reference $U_{ref} = 1.65 \text{ V}$
- $U_{out} - U_{ref} = 460 \text{ mV} @ I_{PN}$

Advantages

- Low offset drift
- Over-drivable U_{ref}
- 8 mm creepage /clearance
- Fast response
- Low profile 2 mm pitch connector for 24 to 32 AWG wire.

Applications

- AC variable speed and servo motor drives
- Static converters for DC motor drives
- Battery supplied applications
- Uninterruptible Power Supplies (UPS)
- Switched Mode Power Supplies (SMPS)
- Power supplies for welding applications
- Combiner box
- MPPT.

Standards

- IEC 61800-2: 2015
- IEC 61800-3: 2004
- IEC 61800-5-1: 2007
- IEC 62109-1: 2010
- UL 508: 2013.

Application Domain

- Industrial.

Safety



Caution

If the device is used in a way that is not specified by the manufacturer, the protection provided by the device may be compromised. Always inspect the electronics unit and connecting cable before using this product and do not use it if damaged. Mounting assembly shall guarantee the maximum primary conductor temperature, fulfill clearance and creepage distance, minimize electric and magnetic coupling, and unless otherwise specified can be mounted in any orientation.



Caution, risk of electrical shock

This transducer must be used in limited-energy secondary circuits SELV according to IEC 61010-1, in electric/electronic equipment with respect to applicable standards and safety requirements in accordance with the manufacturer's operating specifications.

Use caution during installation and use of this product; certain parts of the module can carry hazardous voltages and high currents (e.g. power supply, primary conductor).

Ignoring this warning can lead to injury and or/cause serious damage.

De-energize all circuits and hazardous live parts before installing the product.

All installations, maintenance, servicing operations and use must be carried out by trained and qualified personnel practicing applicable safety precautions.

This transducer is a build-in device, whose hazardous live parts must be inaccessible after installation.

This transducer must be mounted in a suitable end-enclosure.

Besides make sure to have a distance of minimum 30 mm between the primary terminals of the transducer and other neighboring components.

Main supply must be able to be disconnected.

Always inspect the flexible probe for damage before using this product.

Never connect or disconnect the external power supply while the primary circuit is connected to live parts.

Never connect the output to any equipment with a common mode voltage to earth greater than 30 V.

Always wear protective clothing and gloves if hazardous live parts are present in the installation where the measurement is carried out.

This transducer is a built-in device, not intended to be cleaned with any product. Nevertheless if the user must implement cleaning or washing process, validation of the cleaning program has to be done by himself.

When defining soldering process, please use no cleaning process only.



ESD susceptibility

The product is susceptible to be damaged from an ESD event and the personnel should be grounded when handling it.

Do not dispose of this product as unsorted municipal waste. Contact a qualified recycler for disposal.



Underwriters Laboratory Inc. recognized component

Absolute maximum ratings

Parameter	Symbol	Unit	Value
Maximum supply voltage (not destructive)	$\pm U_{C \max}$	V	8
Maximum supply voltage (working) (-40 ... 105 °C)	$\pm U_{C \max}$	V	6.5
Maximum primary conductor temperature	$T_{B \max}$	°C	120
Electrostatic discharge voltage (HBM - Human Body Model)	$U_{ESD \text{ HBM}}$	kV	2

Stresses above these ratings may cause permanent damage.
Exposure to absolute maximum ratings for extended periods may degrade reliability.

UL 508: Ratings and assumptions of certification

File # E189713 Volume: 2 Section: 5

Standards

- CSA C22.2 NO. 14-10 INDUSTRIAL CONTROL EQUIPMENT - Edition 11 - Revision Date 2011/08/01
- UL 508 STANDARD FOR INDUSTRIAL CONTROL EQUIPMENT - Edition 17 - Revision Date 2010/04/15

Ratings

Parameter	Symbol	Unit	Value
Primary involved potential		V AC/DC	600
Maximum surrounding air temperature	T_A	°C	105
Primary current	I_P	A	According to series primary current
Secondary supply voltage	U_C	V DC	5
Output voltage	U_{out}	V	0 to 5

Conditions of acceptability

- 1 - These devices have been evaluated for overvoltage category III and for use in pollution degree 2 environment.
- 2 - A suitable enclosure shall be provided in the end-use application.
- 3 - The terminals have not been evaluated for field wiring.
- 4 - Any surface of polymeric housing have not been evaluated as insulating barrier.
- 5 - Low voltage control circuit shall be supplied by an isolating source (such as a transformer, optical isolator, limiting impedance or electro-mechanical relay).

Marking

Only those products bearing the UR Mark should be considered to be Listed or Recognized and covered under UL's Follow-Up Service. Always look for the Mark on the product.

Insulation coordination

Parameter	Symbol	Unit	Value	Comment
RMS voltage for AC insulation test, 50 Hz, 1 min	U_d	kV	4.3	IEC 60664-1
Impulse withstand voltage 1.2/50 μ s	U_{Ni}	kV	8	IEC 60664-1
Partial discharge RMS test voltage ($q_m < 10$ pC)	U_t	V	>1200	Busbar/Secondary Jumpers/Secondary
Clearance (pri. - sec.)	d_{Cl}	mm	> 8	Shortest distance through air
Creepage distance (pri. - sec.)	d_{cp}	mm	> 8	Shortest path along device body
Case material	-	-	V0	According to UL 94
Comparative tracking index	CTI	-	600	
Application example		V	1000	Basic insulation according to IEC 61800-5-1 CAT III, PD2
Application example		V	600	Reinforced insulation according to IEC 61800-5-1 CAT III, PD2
Application example		V	600	According to UL 508 CAT III, PD2

Environmental and mechanical characteristics

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Ambient operating temperature	T_A	°C	-40		105	
Ambient storage temperature	$T_{A\ st}$	°C	-40		105	
Mass	m	g		32		

Electrical data HO 100-S/SP606-1106

At $T_A = 25^\circ\text{C}$, $U_C = +5\text{ V}$, $R_L = 10\text{ k}\Omega$, unless otherwise noted (see Min, Max, typ, definition paragraph in page 8).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		100		
Primary current, measuring range	I_{PM}	A	-250		250	
Number of primary turns	N_P			1		See application information
Supply voltage ¹⁾	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage (output)	U_{ref}	V	1.63	1.65	1.67	Internal reference
External reference voltage (input)	U_{Eref}	V	0.5		2.65	
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	-1.15		1.15	Over operating temperature range
Internal series resistance of reference voltage	R_{ref}	Ω	130	200	300	Series
Output internal resistance	R_{out}	Ω		2	5	Series
Load capacitance	C_L	nF	0		6	
OCD output on resistance	$R_{on\text{ OCD}}$	Ω	70	95	150	Open drain, active low Over operating temperature
OCD output hold time	$t_{hold\text{ OCD}}$	ms	0.7	1	1.4	Additional time after threshold has released
EEPROM control	U_{out}	mV	0		50	U_{out} forced to GND when EEPROM in an error state ²⁾
Electrical offset voltage @ $I_P = 0\text{ A}$	U_{OE}	mV	-5		5	$U_{out} - U_{ref}$ @ $U_{ref} = 1.65\text{ V}$
Electrical offset current referred to primary	I_{OE}	A	-1.09		1.09	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K	-170		170	-40 °C ... 105 °C
Temperature coefficient of U_{OE} referred to primary	TCU_{OE}	mV/K	-0.075		0.075	-40 °C ... 105 °C
Temperature coefficient of I_{OE} referred to primary	TCI_{OE}	mA/K	-16.32		16.32	-40 °C ... 105 °C
Nominal sensitivity	S_N	mV/A		4.60		460 mV @ I_{PN}
Sensitivity error	ε_S	%	-0.5		0.5	Factory adjustment (straight busbar)
Temperature coefficient of S	TCS	ppm/K	-350		350	-40 °C ... 105 °C
Linearity error 0 ... I_{PN}	ε_L	% of I_{PN}	-0.5		0.5	
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM}	-0.5		0.5	
Magnetic offset current (@ $10 \times I_{PN}$) referred to primary	I_{OM}	A	-0.92		0.92	One turn
Delay time to 10 % of the final output value for I_{PN} step	t_{D10}	μs			2.5	@ 50 A/ μs
Delay time to 90 % of the final output value for I_{PN} step	t_{D90}	μs			3.5	
Frequency bandwidth (-3 dB)	BW	kHz		100		Small signals
Noise voltage spectral density referred to primary (100 Hz ... 100 kHz)	u_{no}	$\mu\text{V}/\sqrt{\text{Hz}}$			4.9	
RMS noise voltage referred to primary (DC ... 10 kHz) (DC ... 100 kHz) (DC ... 1 MHz)	U_{no}	mVpp		2.6 4.7 16.4		
Primary current, detection threshold	I_{PTh}	A	$2.63 \times I_{PN}$	$2.92 \times I_{PN}$	$3.21 \times I_{PN}$	Peak value $\pm 10\%$ overcurrent detection OCD
Sum of sensitivity and linearity error @ I_{PN}	ε_{SL}	% of I_{PN}	-1		1	
Sum of sensitivity and linearity error at 105° C @ I_{PN}	ε_{SL105}	% of I_{PN}	-5.1		5.1	See formula note ³⁾
Sum of sensitivity and linearity error at 85° C @ I_{PN}	ε_{SL85}	% of I_{PN}	-4.08		4.08	See formula note ³⁾

Notes:

¹⁾ 3.3 V SP version available

²⁾ EEPROM in an error state makes the transducer behave like a reverse current saturation. Use of the OCD may help to differentiate the two cases

³⁾ Sum of sensitivity and linearity error @ T_A (% of I_{PN}) = $\varepsilon_{SL} + \left(\frac{TCS}{10000} \times (T_A - 25) \right) + \frac{TCI_{OE}}{10000 \times I_{PN}} \times 100 \times (T_A - 25)$

Electrical data HO 200-S/SP606-1106

At $T_A = 25^\circ\text{C}$, $U_C = +5\text{ V}$, $R_L = 10\text{ k}\Omega$, unless otherwise noted (see Min, Max, typ, definition paragraph in page 8).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		200		
Primary current, measuring range	I_{PM}	A	-500		500	
Number of primary turns	N_P			1		See application information
Supply voltage ¹⁾	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage (output)	U_{ref}	V	1.63	1.65	1.67	Internal reference
External reference voltage (input)	U_{Eref}	V	0.5		2.65	
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	-1.15		1.15	Over operating temperature range
Internal series resistance of reference voltage	R_{ref}	Ω	130	200	300	Series
Output internal resistance	R_{out}	Ω		2	5	Series
Load capacitance	C_L	nF	0		6	
OCD output on resistance	$R_{on\text{ OCD}}$	Ω	70	95	150	Open drain, active low Over operating temperature
OCD output hold time	$t_{hold\text{ OCD}}$	ms	0.7	1	1.4	Additional time after threshold has released
EEPROM control	U_{out}	mV	0		50	U_{out} forced to GND when EEPROM in an error state ²⁾
Electrical offset voltage @ $I_P = 0\text{ A}$	U_{OE}	mV	-5		5	$U_{out} - U_{ref}$ @ $U_{ref} = 1.65\text{ V}$
Electrical offset current referred to primary	I_{OE}	A	-2.17		2.17	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K	-170		170	-40 °C ... 105 °C
Temperature coefficient of U_{OE} referred to primary	TCU_{OE}	mV/K	-0.075		0.075	-40 °C ... 105 °C
Temperature coefficient of I_{OE} referred to primary	TCI_{OE}	mA/K	-32.64		32.64	-40 °C ... 105 °C
Nominal sensitivity	S_N	mV/A		2.30		460 mV @ I_{PN}
Sensitivity error	ε_S	%	-0.5		0.5	Factory adjustment (straight busbar)
Temperature coefficient of S	TCS	ppm/K	-350		350	-40 °C ... 105 °C
Linearity error 0 ... I_{PN}	ε_L	% of I_{PN}	-0.5		0.5	
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM}	-0.5		0.5	
Magnetic offset current (@ $10 \times I_{PN}$) referred to primary	I_{OM}	A	-0.92		0.92	One turn
Delay time to 10 % of the final output value for I_{PN} step	t_{D10}	μs			2.5	@ 50 A/ μs
Delay time to 90 % of the final output value for I_{PN} step	t_{D90}	μs			3.5	
Frequency bandwidth (-3 dB)	BW	kHz		100		Small signals
Noise voltage spectral density referred to primary (100 Hz ... 100 kHz)	u_{no}	$\mu\text{V}/\sqrt{\text{Hz}}$			3.1	
RMS noise voltage referred to primary (DC ... 10 kHz) (DC ... 100 kHz) (DC ... 1 MHz)	U_{no}	mVpp		2.6 4.7 9.5		
Primary current, detection threshold	I_{PTh}	A	$2.63 \times I_{PN}$	$2.92 \times I_{PN}$	$3.21 \times I_{PN}$	Peak value $\pm 10\%$ overcurrent detection OCD
Sum of sensitivity and linearity error @ I_{PN}	ε_{SL}	% of I_{PN}	-1		1	
Sum of sensitivity and linearity error at 105° C @ I_{PN}	ε_{SL105}	% of I_{PN}	-5.1		5.1	See formula note ³⁾
Sum of sensitivity and linearity error at 85° C @ I_{PN}	ε_{SL85}	% of I_{PN}	-4.08		4.08	See formula note ³⁾

Notes:

¹⁾ 3.3 V SP version available

²⁾ EEPROM in an error state makes the transducer behave like a reverse current saturation. Use of the OCD may help to differentiate the two cases

³⁾ Sum of sensitivity and linearity error @ T_A (% of I_{PN}) = $\varepsilon_{SL} + \left(\frac{TCS}{10000} \times (T_A - 25) + \frac{TCI_{OE}}{10000 \times I_{PN}} \times 100 \times (T_A - 25) \right)$

Electrical data HO 250-S/SP606-1106

At $T_A = 25^\circ\text{C}$, $U_C = +5\text{ V}$, $R_L = 10\text{ k}\Omega$, unless otherwise noted (see Min, Max, typ, definition paragraph in page 8).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		250		
Primary current, measuring range	I_{PM}	A	-625		625	
Number of primary turns	N_P			1		See application information
Supply voltage ¹⁾	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage (output)	U_{ref}	V	1.63	1.65	1.67	Internal reference
External reference voltage (input)	U_{Eref}	V	0.5		2.65	
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	-1.15		1.15	Over operating temperature range
Internal series resistance of reference voltage	R_{ref}	Ω	130	200	300	Series
Output internal resistance	R_{out}	Ω		2	5	Series
Load capacitance	C_L	nF	0		6	
OCD output on resistance	$R_{on\text{ OCD}}$	Ω	70	95	150	Open drain, active low Over operating temperature
OCD output hold time	$t_{hold\text{ OCD}}$	ms	0.7	1	1.4	Additional time after threshold has released
EEPROM control	U_{out}	mV	0		50	U_{out} forced to GND when EEPROM in an error state ²⁾
Electrical offset voltage @ $I_P = 0\text{ A}$	U_{OE}	mV	-5		5	$U_{out} - U_{ref}$ @ $U_{ref} = 1.65\text{ V}$
Electrical offset current referred to primary	I_{OE}	A	-2.72		2.72	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K	-170		170	-40 °C ... 105 °C
Temperature coefficient of U_{OE} referred to primary	TCU_{OE}	mV/K	-0.075		0.075	-40 °C ... 105 °C
Temperature coefficient of I_{OE} referred to primary	TCI_{OE}	mA/K	-40.8		40.8	-40 °C ... 105 °C
Nominal sensitivity	S_N	mV/A		1.84		460 mV @ I_{PN}
Sensitivity error	ε_S	%	-0.5		0.5	Factory adjustment (straight busbar)
Temperature coefficient of S	TCS	ppm/K	-350		350	-40 °C ... 105 °C
Linearity error 0 ... I_{PN}	ε_L	% of I_{PN}	-0.5		0.5	
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM}	-0.5		0.5	
Magnetic offset current (@ $10 \times I_{PN}$) referred to primary	I_{OM}	A	-0.92		0.92	One turn
Delay time to 10 % of the final output value for I_{PN} step	t_{D10}	μs			2.5	@ 50 A/ μs
Delay time to 90 % of the final output value for I_{PN} step	t_{D90}	μs			3.5	
Frequency bandwidth (-3 dB)	BW	kHz		100		Small signals
Noise voltage spectral density referred to primary (100 Hz ... 100 kHz)	u_{no}	$\mu\text{V}/\sqrt{\text{Hz}}$			2.9	
RMS noise voltage referred to primary (DC ... 10 kHz) (DC ... 100 kHz) (DC ... 1 MHz)	U_{no}	mVpp		2.6 4.7 8.2		
Primary current, detection threshold	I_{PTh}	A	$2.63 \times I_{PN}$	$2.92 \times I_{PN}$	$3.21 \times I_{PN}$	Peak value $\pm 10\%$ overcurrent detection OCD
Sum of sensitivity and linearity error @ I_{PN}	ε_{SL}	% of I_{PN}	-1		1	
Sum of sensitivity and linearity error at 105° C @ I_{PN}	ε_{SL105}	% of I_{PN}	-5.10		5.10	See formula note ³⁾
Sum of sensitivity and linearity error at 85° C @ I_{PN}	ε_{SL85}	% of I_{PN}	-4.08		4.08	See formula note ³⁾

Notes:

¹⁾ 3.3 V SP version available

²⁾ EEPROM in an error state makes the transducer behave like a reverse current saturation. Use of the OCD may help to differentiate the two cases

³⁾ Sum of sensitivity and linearity error @ T_A (% of I_{PN}) = $\varepsilon_{SL} + \left(\frac{TCS}{10000} \times (T_A - 25)\right) + \frac{TCI_{OE}}{10000 \times I_{PN}} \times 100 \times (T_A - 25)$

Definition of typical, minimum and maximum values

Minimum and maximum values for specified limiting and safety conditions have to be understood as such as well as values shown in "typical" graphs.

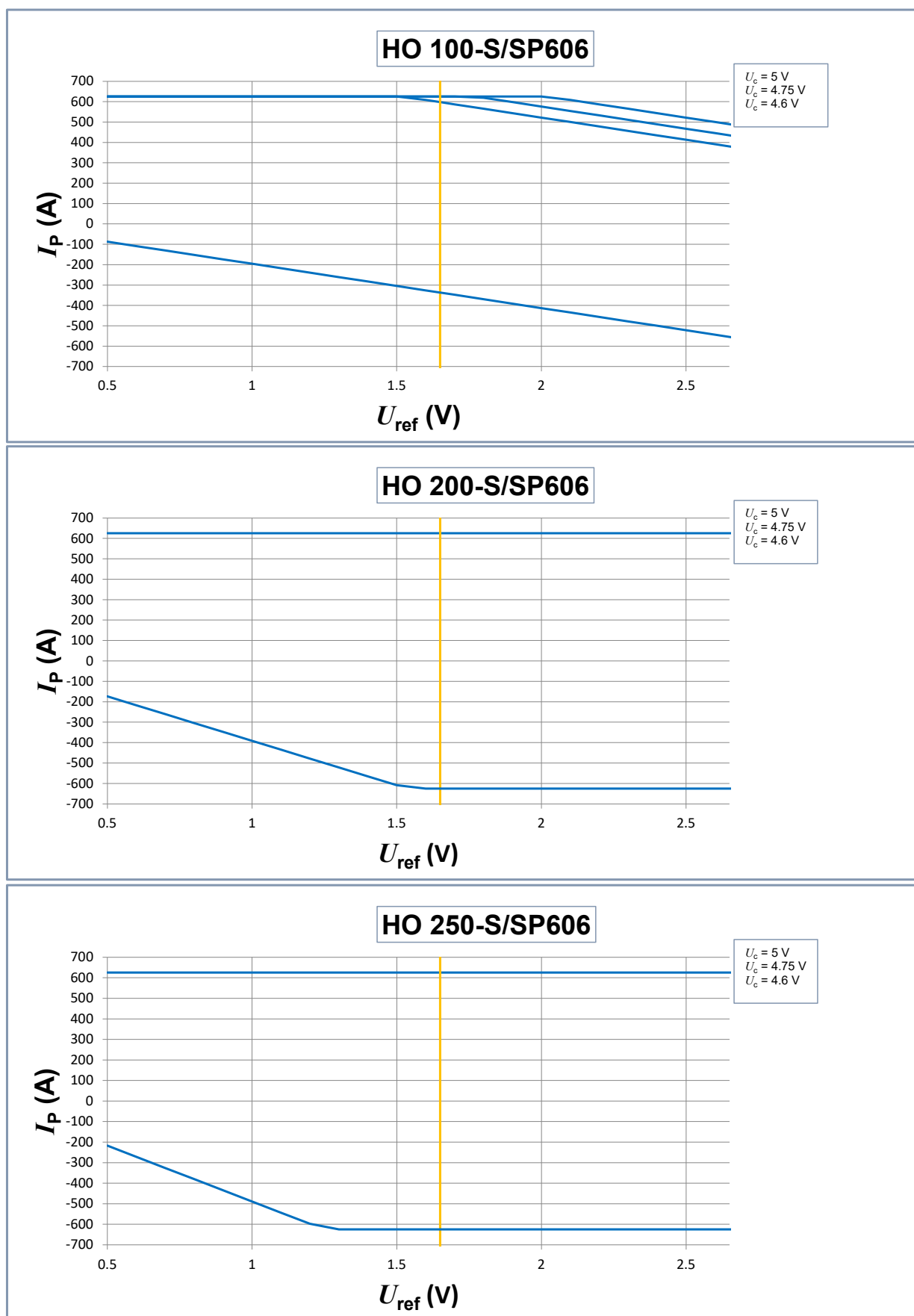
On the other hand, measured values are part of a statistical distribution that can be specified by an interval with upper and lower limits and a probability for measured values to lie within this interval.

Unless otherwise stated (e.g. "100 % tested"), the LEM definition for such intervals designated with "min" and "max" is that the probability for values of samples to lie in this interval is 99.73 %.

For a normal (Gaussian) distribution, this corresponds to an interval between -3σ and $+3\sigma$. If "typical" values are not obviously mean or average values, those values are defined to delimit intervals with a probability of 68.27 %, corresponding to an interval between $-\sigma$ and $+\sigma$ for a normal distribution.

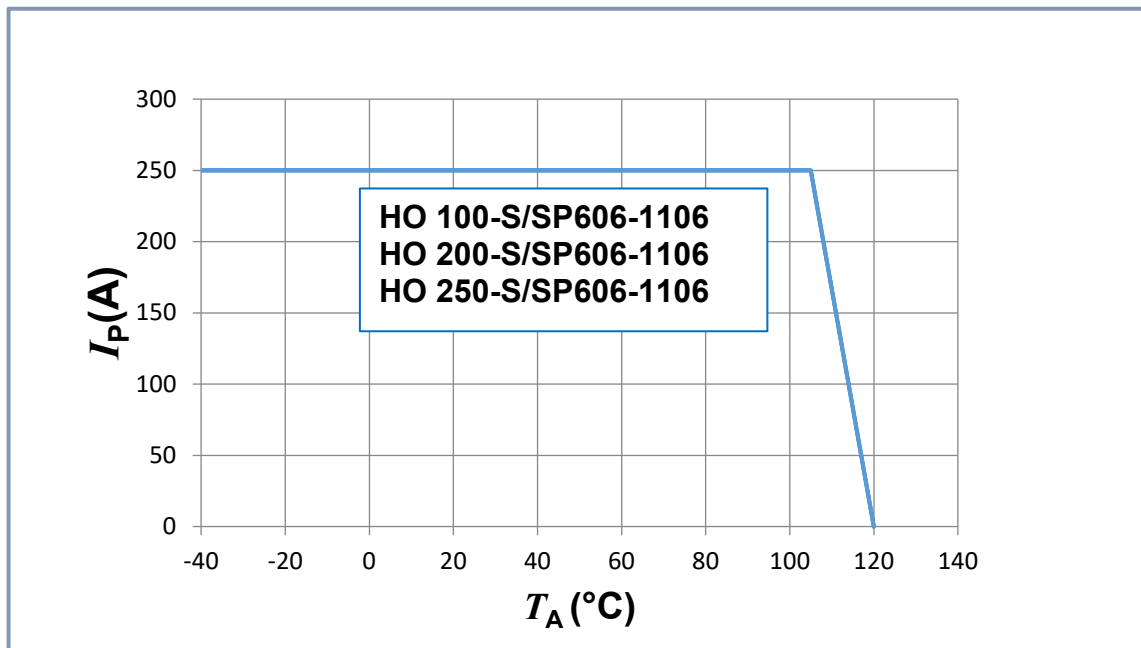
Typical, maximal and minimal values are determined during the initial characterization of the product.

Measuring range versus external reference voltage



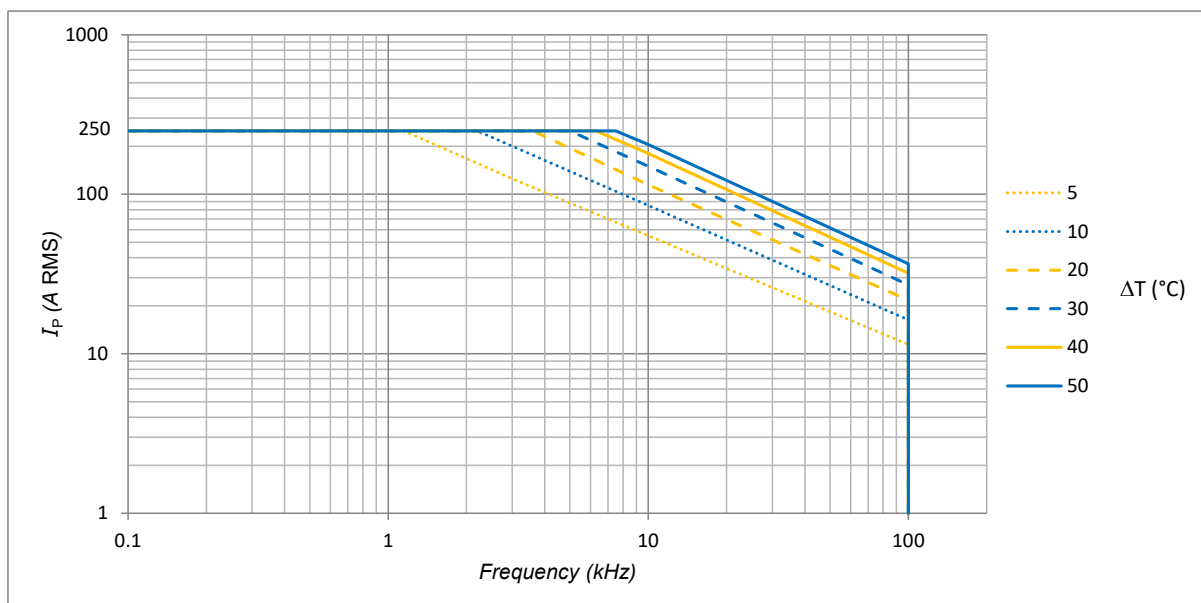
Maximum continuous DC current

For all ranges:



Important notice: whatever the usage and/or application, the transducer primary bar temperature shall not go above the maximum rating of 120 °C as stated in page 3 of this datasheet.

Frequency derating versus primary current and core temperature increase ΔT (°C)



Primary current in A RMS is sine wave.

Example:

Primary current ripple (sine wave): 50 A RMS

Ripple frequency: 20 kHz

- the core temperature increase is 10 °C

HO-S/SP606 series: name and codification

HO family products may be ordered **on request**¹⁾ with a dedicated setting of the parameters as described below (standards products are delivered with the setting 1106 according to the table).

HO-S/SP606-XXXX									
Internal reference ²⁾		Response time		EEPROM Control		Over current detection ($\times I_{PN}$) ³⁾			
0	Not used	0	4 μ s	0	YES	0	5.10	A	1.18
1	1.65 V	1	3.5 μ s	1	NO	1	6.24	B	1.62
2	Not used	2	6 μ s			2	6.94	C	2.04
3	Not used					3	8.36	D	2.51
4	Not used					4	9.03	E	2.78
						5	10.02	F	3.32
						6	2.92	G	3.62
						7	4.09	H	4.01

Notes: ¹⁾ For dedicated settings, minimum quantities apply, please contact your local LEM support.

²⁾ U_{ref} electrical data

U_{ref} parameter	U_{ref} (V)			TCU_{ref} (ppm/K)	
	min	typ	max	min	max
0	2.48	2.5	2.52	-170	170
1	1.63	1.65	1.67	-170	170
2	1.48	1.5	1.52	-170	170
3	0.49	0.5	0.51	-250	250

³⁾ OCD ($\times I_{PN}$) correction table versus range and temperature
All other values or empty cells: no change

HO-S/SP606-1106			
OCD Parameter	100	200	250
A			
B			
C			
D			
E			
6			
F			
G			
H			
7			
0			6.90
1		8.11	-
2		-	-
3		-	-
4		-	-
5		-	-

Tolerance on OCD value	
± 20 %	
± 15 %	
± 10 %	No change
-	Do not use

Application information

- HOxx-S/SPxx series is designed to use a busbar or a cable ¹⁾ to carry the current through out the aperture with a maximum cross section of 8 × 15 mm.

Remark

Installation of the transducer must be done unless otherwise specified on the datasheet, according to LEM Transducer Generic Mounting Rules. Please refer to LEM document N°ANE120504 available on our Web site:

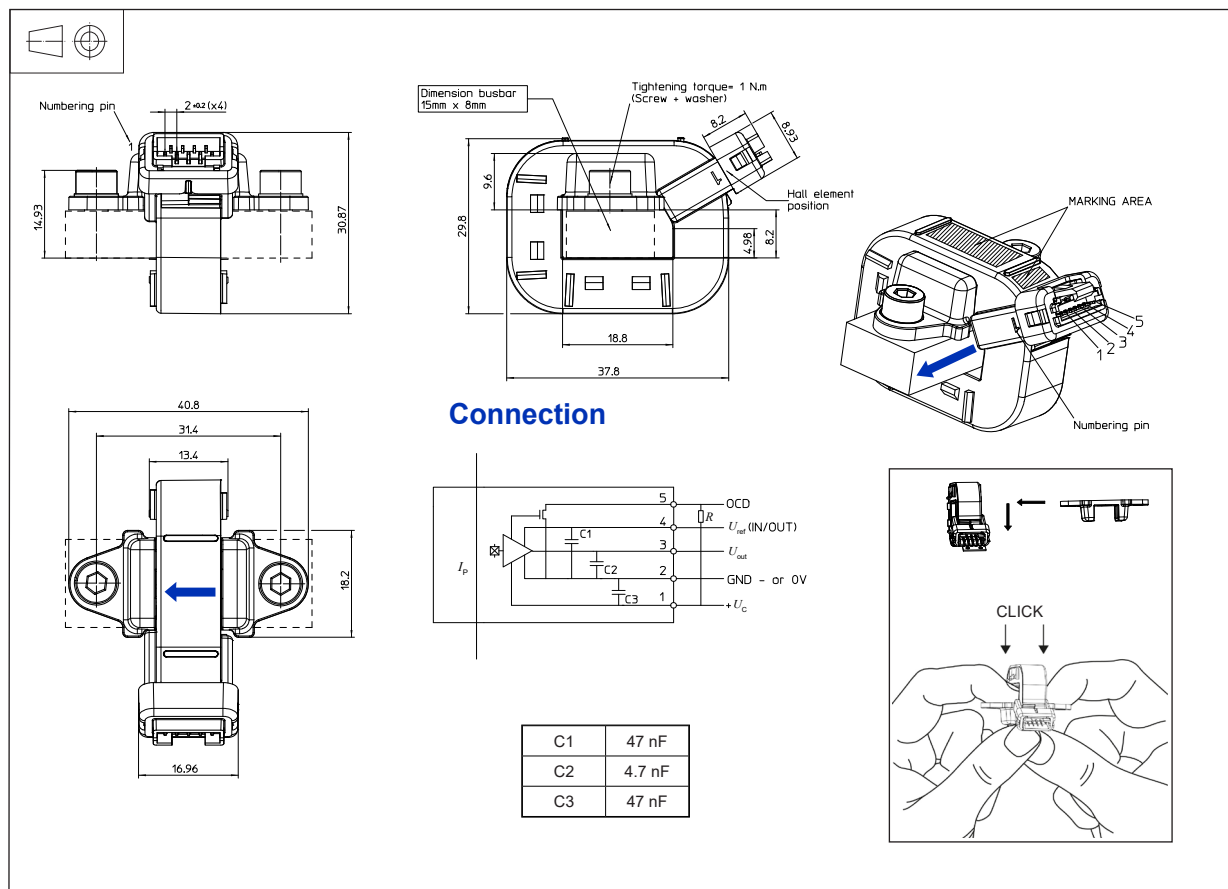
<https://www.lem.com/en/file/3137/download/>.

Insulation distance (nominal values):

	d_{cp}	d_{cl}
Between primary busbar and secondary pin	14.6 mm	-
Between primary busbar and core	-	11.34 mm
Between core and secondary terminal	-	1.18 mm

Note: ¹⁾ The maximum magnetic offset referred to primary is inversely proportional to the number of turns, thus is divided by 2 with 2 turns.

Dimensions (in mm, general tolerance ± 0.3 mm)



Remarks

- U_{out} is positive with respect to U_{ref} when positive I_p flows in the direction of the arrow shown on the drawing above.
- Connection system: equivalent to JST B5B-PH type.